

Chapter 3.1 SURFACE WATER MONITORING PROGRAMS

Ambient Water Quality Monitoring (AWQM)

From January 1994 to December 1998 approximately 1400 stations were sampled by DEQ staff for physical and chemical parameters. Approximately 70% of those stations were sampled ten times or more over the five year period and about 30% were sampled 24 or more times. The monitoring network includes ambient water quality and Chesapeake Bay tributary stations, as well as stations located specifically for special studies. During this reporting period, DEQ collected in excess of 30,000 samples.

Stations are located to gather information from industrial, urban, rural, and undeveloped areas of the state. These data are gathered near industrial and municipal discharges, nonpoint source areas, public water supplies, unaffected areas, and previously unassessed areas. In this way, stream miles at risk from major pollution sources are well documented, as are those where pollution risk is suspected or unknown. Regional office personnel who are most familiar with local conditions and concerns make station selections.

The number of stations representing a particular type of stream segment, the types of samples collected, the parameters analyzed, and the sampling frequency all vary with prevailing conditions, and program emphasis. Types of substrates collected include water and sediment. All stations are monitored for conventional parameters, about one-third are monitored for toxics in the sediments, and a smaller number are monitored for toxics in the water column (primarily trace metals). Areas with potentially greater risk are sampled more frequently, with more types of samples being collected. As the risk decreases, the sampling frequency and the number of the types of samples collected decreases. Table 3.1-1 gives an outline of the frequency of sampling and parameters covered for given sample types.

Each basin summary, found in Chapter 2.6 of this report, lists the ambient water quality monitoring (AWQM) and biological (benthic) monitoring summary data within the basin. In some basins, STORET data produced from Tennessee Valley Authority (TVA) and USGS monitoring operations are included in order to provide better assessment of water quality. Summaries of the sampling data collected at each station during the reporting period are provided in Appendix B of this report. All chemical and physical data (except for special studies) collected at the AWQM stations are entered into EPA's STORET database.

Data Management

Virginia uses WQM (Water Quality Monitoring), an in-house database application, for data management. The system begins with the entry of field parameters by field technicians followed by the electronic data transfer of field data and requested services to the Division of Consolidated Laboratory Services. Analyte data are reported back to DEQ by the laboratory and screened for QA/QC problems and Standards violations. Restricted DEQ personnel may correct, delete or erase stored data using an electronic interface. Data are managed by central office personnel using routines created locally with in-house software. Ambient water quality monitoring data are available to anyone with WQM access. Data can be provided to persons without such access in hard copy and digital formats by contacting the DEQ STORET coordinator at (804) 698-4449.

Table 3.1-1 Ambient Monitoring Program sample types, analyses conducted, and frequency of

Water		Sediment	
Parameters:			
DO		Metals	
Temperature		Pesticides	
pH		Organics	
Bacteria			
Solids			
Nutrients			
Conductivity			
Salinity			
Secchi			
Alkalinity			
Acidity			
Total Solids			
Suspended Solids			
Dissolved Solids			
Silica			
Sulfide			
Color			
Tannin & Lignin			
BOD			
COD			
TOC			
Hardness			
Chloride			
Fluoride			
Metals			
Pesticides			
Organics			
Chlorophyll			
Algae			
Sampling Frequency:			
Annual		Annual	
Semiannual		Semiannual	
Quarterly		Quarterly	
Monthly			

analyses

Fish Tissue and Sediment Monitoring Program

DEQ monitors concentrations of chemical contaminants, including heavy metals and organic pollutants, in fish and shellfish tissue and sediment in order to assess the human health risks for individuals who may consume fish from state waters. Additionally, these contaminants are used to identify impaired aquatic ecosystems.

A two tiered sample strategy is followed which is consistent with federal guidance for fish tissue and sediment contamination monitoring programs.

Tier I is a screening study of a relatively large number of sample stations to identify sites where concentrations of contaminants in stream sediments and/or the edible portions of fish indicate potential aquatic ecosystem impairment and/or significant health risks to human consumers. Tier I sample stations are selected on a rotational river basin approach among all the river basins in Virginia. Approximately 30 - 45 stations are selected among two river basins per year; the Code of Virginia § 62.1-44.19.5 requires maintenance of the 1996 level of tissue and sediment sampling which equates to a minimum of 24 sample stations per year. Several criteria are used to select the sample stations and include correspondence with the DEQ-Waste division to identify contaminated waste sites that may impact tissue and sediments in aquatic environments, regional office recommendations, extensive literature searches, important recreational and/or commercial fisheries (Department of Game and Inland Fisheries, 1996), close proximity to point source discharges, and coverage of the entire watershed, i.e. headwater as well as higher order streams. Routinely, three species of fish (top level predator such as a largemouth bass, mid-level predator such as a bluegill, and a bottom feeder such as catfish) are collected at each station. Five to ten adult specimens of each species are composited into one sample, resulting in three tissue samples per station.

Tier I analytical results for fish tissue are expressed in wet-weight and are compared to contaminant screening values that are computed using EPA risk assessment techniques for noncarcinogen and carcinogen effects. The State Water Control Board adopted the risk level of 10^{-5} and this is used in the calculations for carcinogen effects. Analytical results for contaminants in sediments are expressed in dry-weight and are compared to effects range-low and effects range-median screening values provided by the National Oceanic and Atmospheric Administration to assess the potential effects of sediment contamination to aquatic life. For additional information, visit the DEQ website at www.deq.state.va.us/rivers/fishsed.html.

If tier I results indicate problems exist, then a second more intensive tier II study is initiated to determine the magnitude and geographical extent and potential source(s) of contamination in the sediments and/or fish.

The program fulfills the Clean Water Act § 106 United States Environmental Protection Agency (EPA) grant requirements for the collection of fish tissue and sediment. Data generated by the program are used by the Virginia Department of Health to determine the need for fish consumption advisories and/or bans. Data are also used by the DEQ and other state and federal agencies to assess the environmental quality of Virginia's waters. The following is a list of those compounds analyzed.

<u>Metals:</u>	<u>Pesticides:</u>	
Arsenic	Aldrin	Endosulfan (alpha)
Beryllium	Dieldrin	Endosulfan (beta)
Cadmium	Endrin	Total PCBs
Chromium	DDT	Toxaphene
Copper	DDE	Benzene hexachloride (alpha)
Lead	DDD	Benzene hexachloride (beta)

Mercury	Chlordane	Lindane
Nickel	Heptachlor	Benzene hexachloride (delta)
Selenium	Heptachlor epoxide	Chlorpyrifos-methyl
Silver	Hexachlorobenzene	Mirex
Thallium	Methoxychlor	Oxychlordane
Zinc	Nonachlor	Pentachloroanisole
	Dicofol	Polybrominated diphenyl ethers (BDEs)

Other Organics:

Acenaphthene	Diethylphthalate	Total PAHs
Acenaphthylene	Dimethylphthalate	Benzo (e) pprrene
Anthracene	Fluoranthene	Benzo (b) fluoranthene
1,2 Benzanthracene	Fluorene	Benzo (a) anthracene
Benzo (a) pyrene	Ideno (1,2,3-cd) pyrene	Benzo (g,h,i) perylene
3,4 Benzofluoranthene	Naphthalene	Benzo (l) fluoranthene
Benzo (k) fluoroanthene	4,6-Dinitro-2-methylphenol	
1,1,2, Benzoperylene	N-Nitrosodiphenylamine	
4-Bromophenyl phenylether	N-Nitroso-di-N-propylamine	
4 Chloro-3-methylphenol	Phenanthrene	
2-Chloronaphthalene	Bis (2-ethyl-hexyl) phthalate	
4-Chlorophenolphenylether	Butylbenzylphthalate	
Chrysene	Di-N-butylphthalate	
Dibenzo (a,h) anthracene	Di-N-octylphthalate	
3,3-Dichlorobenzidine	Pyrene	
2,4-Dimethylphenol	1,2,4-Trichlorobenzene	

Benthic Macroinvertebrate Monitoring Program

The Biological Monitoring Program (BMP) utilizes the study of bottom dwelling macroinvertebrate communities to determine overall water quality. Changes in water quality generally result in changes in the kinds and numbers of these animals that live in streams or other waterbodies.

The majority of the freshwater benthic macroinvertebrates found in Virginia come from four general groups: insects, molluscs, crustaceans, and annelid worms. Beside being the major intermediate constituent of the aquatic food chain, benthic macroinvertebrates are "living recorders" of past and present water quality conditions. This is due to their relative immobility and their variable resistance to the diverse contaminants that can be introduced into streams. No two groups of benthic organisms have the same limiting factor for the various chemical and physical constituents encountered in the aquatic ecosystem. The community structure of these organisms provides the basis for the biological analysis of water quality.

The BMP is composed of 150 to 170 stations that are examined annually during the spring and fall. Qualitative and semiquantitative biological monitoring has been conducted by the agency since the early 1970's. The US EPA Rapid Bioassessment Protocol (RBP) II was employed beginning in the fall of 1990 to utilize standardized and repeatable methodology. The RBP's produce water quality ratings of nonimpaired, slightly impaired, moderately impaired and severely impaired instead of the former ratings of good, fair and poor.

The procedure evaluates the macroinvertebrate community by comparing ambient monitoring "network" stations to "reference" sites. A reference site is one which has been determined to be representative of a natural, unimpaired waterbody. The RBP evaluation also accounts for the natural variation noted in streams in different ecoregions. One additional product of the RBP evaluation is a habitat

assessment. This provides information on the comparability of each stream station to the reference site.

The results of data analyses and locations of stations are presented in Appendix B of this report. Like physical and chemical water quality monitoring data, biological monitoring data are used to assess water quality for support of aquatic life designated use and the Clean Water Act "fishable and swimmable" goals.

Citizen Monitoring

Citizen-collected water quality data has been considered in Virginia's Water Quality assessments for many years. Past 305(b) reports have used citizen data as cursory information. In 1998, the creation of the position of Citizen Monitoring Coordinator within the Department of Environmental Quality's Office of Water Quality Assessment and Planning, has facilitated the use of citizen collected data in this and other water quality reports. The Citizen Monitoring Coordinator is responsible for collecting citizen-generated data and cataloging and formatting the data for agency use. The Department envisions improvements in the quality and quantity of citizen-collected data as well as future enhancements in the agency use of citizen-collected data.

There are many citizen organizations throughout the Commonwealth with water quality monitoring programs. These programs vary in sophistication and in parameters monitored but all of this citizen-generated data is important in characterizing the state of Virginia's waters. Specific citizen monitoring data is included in most of the river basin summaries and in Appendix B of this report. To understand the information included in the river basin summaries, a general discussion of citizen collected data follows.

Citizens monitor streams, lakes, and estuaries for a variety of parameters. Chemical measures include the conventional parameters of pH and dissolved oxygen and also nutrient parameters such as different forms of nitrogen and phosphorus and ammonia. While most citizen volunteers monitor the physical measure of water temperature, some organizations also include some measure of turbidity or solids (also physical measures). Biological parameters measured by citizen monitors include benthic macroinvertebrates, fecal coliform, and chlorophyll a. Benthic macroinvertebrate assessments are the most common of these, as the other two parameters require access to a lab and expensive lab equipment.

The predominance of chemical vs. benthic macroinvertebrate sampling is divided in the state. Chemical monitoring predominates in the eastern portion of the state (east of Richmond) while benthic macroinvertebrate monitoring predominates in the western portion of the state. This split is consistent with the physiographic change from high, to medium, to low gradient streams. The most popular macroinvertebrate monitoring method is not suited for monitoring low gradient streams. Low gradient streams lack the "riffles" that are generally monitored for macroinvertebrate populations.

Another difference between citizen monitoring programs is the development of quality assurance program plan (QAPP). Few organizations in the state operate under a QAPP. While all water quality data generated throughout the state is important for this report, data collected under a QAPP is considered more reliable and is directly used in this report and in the overall water management programs. Citizen data collected under a QAPP is used in the designated use attainability analysis and is included in Appendix B of this report. Data from citizen volunteers will assist water quality agencies in prioritizing future monitoring and restoration work.

In the citizen summaries several terms are used that are defined as follows:

Certified volunteers: Virginia -Save Our Streams (VA-SOS) program volunteers that have gone through training and testing process as identified in the VA-SOS QA/QC program plan.

Benthic Macroinvertebrate monitoring: performed by VA-SOS monitors. Careful observations of the

macroinvertebrate (bottom-dwelling insects and crustaceans) community in a stream that can give an indication of long-term water quality conditions.

VA-SOS stream ratings: four ratings - excellent, good, fair, and poor

It should be noted that some citizen-collected data is not found in this report. This is primarily data that was not submitted to the Department of Environmental Quality in time to develop this report.